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ABSTRACT

Presented is a discussion of how man first thought about authority, origins of authority, and a consideration of belief and authority. Progress in science and behavior of scientists is considered. (EB)

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Conservatism and Innovation in Science
A Continuing Quest for Authority

Arnold W. Ravin

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It is difficult to be a rational animal. To be rational involves more than making generalizations from observations of nature and human behavior; it involves having an understanding of how nature operates and of man's place in nature. Such understanding makes men aware of consequences of human actions in a context of conditions that are largely, if not wholly, independent of men. With such understanding, however faulty or primitive, men cannot avoid choosing between alternative possibilities of action, for different risks or benefits are seen to be incurred by the various possibilities. Choice is difficult, for how can we be sure that our assessment of risks and benefits is correct, that our understanding of nature upon which that assessment is based is indeed correct?

Yet being rational seems to be the lot of mankind, insofar as rationality distinguishes man from animals. If man is as much the product of evolution as are other living organisms, we must imagine his distinctive characteristics to be themselves the products of an evolutionary process. We might suppose, therefore, that rational behavior was once advantageous in a competition for survival. But granted this human characteristic once promoted the survival of incipient man, may it no longer benefit the mature species? Rationality in early man, even when conducted on a relatively solitary and unsophisticated basis, may have provided him a marginal but significant advantage in his competition with other species for limited resources. But with the maturing of the human species through the evolution of language, cultural transmission, and social organization, rational behavior risks being detrimental whenever it does not lead to shared beliefs and communal decisions.

Hannah Arendt speaks to this point when she refers to the crisis of our times as a crisis of authority.[1] Authority, as we have come to learn, derives from a set of beliefs shared by the members of a human society. Failure of authority follows from a loss of shared beliefs or from a failure to replace one set of beliefs that no longer satisfies the members of society with another that does. Society, as an organized group of functionally differentiated, interdependent beings, cannot function without authority. For if there were not general agreement about the operation of nature and of the human condition, or at least about who possessed such knowledge, how could men cohere? Moreover, if it is true that the crisis of our times consists in a loss of authority, how will men cope with that loss?

An examination of how men first thought about authority may help us in dealing with the future. We may do no better than follow Hannah Arendt in this examination. In her admirable essay, "What is Authority?"[2] she points out three important developments in the concept of authority in the Western world. In Plato's idea of the philosopher-king resides the notion that those who know should rule those who do not. For Plato, then, men did not share equally in the capacity for understanding nature, and since wise actions depend upon such understanding, the many should carry out the instructions of the few who know. For Plato and for subsequent generations the significant problem was coercion of the many by the few, for how could the many limited in their ability to reason and understand be persuaded?

Persuasion is no problem if there is a tradition of beliefs traceable to the founders of a society. Continuity is in itself assurance of correct belief, for what better criterion is there of the correct than success, the success of a society that has persisted and expanded since its origin? For the Romans this notion of authority based on foundation and tradition was especially strong. Obviously traditional beliefs may be shared by all, and individual differences in the power to reason become less consequential for the maintenance of society.

It may seem ironical that the Platonic view of the tyranny of reason should appear within a republican form of government while the Roman concept of democratically shared tradition should be maintained under tyrannical rulers. We may surmise that difficulties encountered with one form of authority generated new beliefs. There is evidence to support this surmise. While Plato sought to coerce the majority by the fears of a vengeful afterlife, an afterlife in which he probably did not himself believe, the Christian Church Fathers, after the demise of the Roman Empire and the rise of new political states tied to Christian theology, found the rewards of heaven and the tortures of hell a powerful doctrine for winning allegiance to new rulers of Church and State. One may establish new authorities with new beliefs.

The lesson to be gained from this brief sketch of the origins of authority is that authority is subject to change. Admittedly authority is rarely missing from the governance of men. Yet men have governed themselves in different ways in different times. One legitimately wonders what is changing, and one cannot avoid suspecting that it is our beliefs that change. If these suspicions are well-grounded, we would be well advised to examine closely the ways by which men come to change their beliefs. We can scarcely do better than study the history of science as a model of changing beliefs, for, as I shall attempt to show in what follows, science may be properly regarded as a continuing, evolving quest for authority.

I would not be original in suggesting that a man believes what he finds to render consistent and compatible the events that he daily observes. He believes that which makes sense and upon which he can rely. If I believe thus and so, it is because my whole world of experience is thereby explained to my satisfaction. I know, moreover, what I may expect to follow from certain actions of men or from certain phenomena of nature, and I have a way of protecting myself and those I care for from that which may be injurious and of seeking for them instead that which may be beneficial. Science is not the exclusive provider of such beliefs, of course. Where science does differ from other modes of acquiring belief, however, is in its relative openness to critical examination. Where tradition may provide beliefs that depend upon the ultimate wisdom of its founder, science may be challenged anew at any time. Despite the challenges, which are not merely potential but are often realized, science does manifest a conservatism differing only in degree from that usually assiciated with tradition. For scientific beliefs do not fall or change every day. Yet change, on the other hand, does occur, and when it does, it sometimes takes on aspects of revolution.

In science as in politics authority and power are often coupled in our minds. Still, as Hannah Arendt has convincingly argued for political power and authority, the two are not the same.[3] The powers of a ruler or a ruling class are often exercised when authority is threatened or weakened. On the contrary, where there is widespread acceptance of authority, power may be relaxed. Violence erupts when authority is lacking, however powerful may be the targets of violence within society.[4] The source of political authority, Arendt reminds us, lies in a realm outside that of power. There is a striking analogy here to the authority and power of science. The quest for authority in science is motivated by the regularity and order that scientists perceive to underlie natural phenomena. The regularity and order they observe are expressed by scientists in the form of "laws of nature."[5] While they may express these laws imperfectly and while they may have to revise their formulations of these laws as new observations are made, the fundamental concept most scientists share is that of an eternal (and, they hope, a simple) set of relationships that governs all of nature. These natural laws govern, in a significant sense, independently of man and independently of whether we recognize them or not. These laws are the final authority. If we could perceive them correctly, we might gain absolute power to predict and to control. Insofar as our perceptions of these laws remain imperfect, our powers are limited but real. Technology is the real demonstration of this limited power, but we need to be reminded that technology is an optional exercise of the power of science while the authority of science is vested in laws that govern regardless of our intentions or capacity to translate beliefs into deeds. Natural laws, if they are deserving of the name, cannot be broken.

They can be ignored. But the sense of power that man has acquired through his developing perception of the laws of nature has proved irresistible. Understandable then that, once the consequences of a scientific quest for authority were realized, men have sought to obtain as complete a knowledge as possible of the laws of nature.[6] For man's powers to predict and control are as great as the completeness of this knowledge. Scientists are moved -- we may even say they are often encouraged -- to perfect their knowledge, as though such perfection were possible. Once scientists believe they have discovered one of the fundamental laws of nature, they are therefore reluctant to entertain its denial. "Trust theories, not facts," young scientists are often advised in only partial jest. The reason is sound. A good theory is hard to come by. It was originally enunciated as a valid explanation of a large set of observations that had been made in a certain domain of inquiry. It furthermore predicted a set of observations not yet made, and when the appropriate means were at hand, the predictions were confirmed. The good theory, moreover, subsumed within a simplifying and unifying framework many odds and pieces of facts and generalizations and made a single field out of what was once a disordered array. No surprise, then, that we scientists should disallow a single new observation to discard a good theory. Perhaps, we hope, the observation was improperly made or the data misinterpreted. Herein lies the conservatism of science. We will not lightly espouse a theory, but once we are persuaded of its virtues, we will not lightly give it up. Thomas Kuhn has referred to this propensity of scientists to work

within a single satisfying theoretical framework as "normal science."[7] He has, in fact, suggested the term "paradigm" for that theoretical framework,[8] and although others have justifiably criticized the ambiguity of this term, the notion that scientists seek to reinforce the insight into nature they have obtained, rather than to overthrow it, strikes a responsive chord in me. Admitting the looseness of this expression, I shall nevertheless agree that scientists normally spend much of their time in "paradigm reinforcement," in demonstrating their beliefs to be true. They seek to establish the truth of what they know by revealing "how it works," how it answers questions and solves puzzles, how it points the way to new discoveries, how it makes possible the control of phenomena we wish to control.

There is another side to this story. If "paradigm reinforcement" were all there were to science, there would be little change in scientific beliefs. Yet we are aware of the revolutionary consequences, not only to our conception of nature but also to our view of man in nature, of the overthrow of the Ptolemaic system of the celestial bodies, of the replacement of a static conception of living species by an evolutionary model, of the introduction of the uncertainty principle into our conception of the physical universe, of the modern interpretation of heredity as an organization of molecular genes. There <u>are</u> scientific revolutions, indeed. How would they occur if the reinforcement of paradigms were not merely a normal but an exclusive activity of science? The apparent paradox is resolved upon examining the manner in which scientists check the validity of their insights. A good theory, I have said, is one that "works." There cannot be one instance of its failure to explain, no one prediction that fails of confirmation. However much confidence a scientist may have in his theoretical framework, as based on previous experience, and however reluctant he may be to abandon that framework, he has no alternative but to expose it continually to new risks. Every potential reinforcement of a paradigm is in fact an opportunity for its overthrow. As Popper rightly emphasizes,[9] no single verification of an hypothesis is sufficient to assert its eternal truth, but one failure of confirmation, as when the contrary of a predicted outcome actually issues from an experiment, is enough -- at least in the ideal case -- to discard the hypothesis. What is a theory, or a natural law as expressed by man, but an hypothesis that has withstood many tests but must face many more?

We are reluctant in science to give up a good theory. But there comes a time when we must, when we do. Nearly always, however, we have something better to turn to -- or at least so we come to think -- when we give up what we once believed. This phenomenon of replacement is important for our general considerations of authority. It is difficult to imagine the abandonment of a scientific theory when there is no successor at hand. Such a state of affairs in science only underscores what I have earlier said about the authority of science. Regularity and order reign in nature whatever the outcome of our feeble efforts to discern its laws. This being the case, the failure of one effort invites us to make another. The enterprise would be futile if we did not profit from the experience of failure, if the new paradigm did not do more than the one it replaces. Whether the superiority of the replacing paradigm is an illusion or not I shall touch upon later in this essay. It is only

relevant for our present discussion of belief and authority that scientists believe in the progress of science and behave accordingly. Hence, the innovator in science is not altogether an unwelcome revolutionary. Rather he attests to the authority of science insofar as his new theory widens the scope of our understanding.

In retrospect, too, the innovator gains our respect for the sheer magnitude of his intellectually imaginative effort. Although to the layman science often seems to proceed by the laborious if not tedious acquisition of facts, the mere accumulation of observations does not in itself lead to understanding since a theory which does provide understanding is not simply deducible from the facts.[10] The discovery of the atom or the gene is more an invention of the primed imagination than it is the revelation of some new object by some powerful instrumental aid to our senses. The making of theory is a creative activity requiring an intuitive leap, an "insight" or new way of looking at phenomena, and is probably in this respect not unlike creative work in the humanities. A scientific theory does not issue from a void, however, any more than does an artistic or literary creation. Far from wiping his mental slate clean and starting from a tabula rasa, the creative scientist draws upon his entire repertoire of experience in searching for that idea which will make sense out of the more limited range of phenomena upon which he has fastened his attention. Beyond recognizing the roles that genius and imagination play, we know sadly little more about the intellectual processes involved in theory creation.

Granted the importance of the individual endeavor in creating theories, the authority of science is nevertheless strengthened by the communality of the enterprise. It is the eventual sharing of beliefs through a cooperative undertaking of vast dimensions in space and time that gives authority to the scientific enterprise. That authority appears weakened when doubt and disagreement arise over questions of fact or interpretation at critical episodes in the history of science. That authority is re-established when a unifying paradigm satisfies and wins the allegiance of the scientific community. That is why, in a real sense, the authority of science both depends upon and induces honesty of communication, mutual information, and sharing of knowledge. I have, of course, somewhat glorified the collegiality of scientists. The men of science have their human frailties as well as other men. But there is no denying the cooperativeness that science demands of its practitioners and the authority that cohesion induces.[11]

The argument that the crisis of our times is due to a loss of authority must contend with the phenomenon of the authority of science. Has there in fact been a dissolution of the authority of science corresponding to the breakdown of political authority that Arendt has indicated? If I am right that scientific authority resides ultimately in the regularity and order that men have perceived in nature, a loss of such authority would be based upon a growing idea of disorder in nature, upon a developing view that we must not trust our senses because order is an illusion while reality is chaos. I doubt that such a philosophy of disorder has taken hold of men's minds. The regularity of night and day and of the seasons, the regularity of heredity

(human ova when fertilized still give rise to individuals we distinguish as humans while fertilized chick eggs still give rise to chickens), the regularity of chemical processes (a substance we need to breathe is still removed from air when bodies are combusted) are illustrations of an order we continue to depend upon.

One might argue, however, that it is not the ultimate authority of nature that men doubt but rather the human capacity to know its laws. After all, have not the paradigms of science undergone great changes, revealing the uncertainty of scientific knowledge? The answer depends upon one's view of scientific change. Is it progress, an orderly albeit gradual movement toward a more perfect, a complete knowledge, or is any fundamental change in scientific thought logically unrelated to previous thought? This is a burning question nowadays for historians and philosophers of science.[12] (Scientists for the most part seem to be too preoccupied to be concerned with the issue.) If the issue is resolved in favor of the view that scientific revolutions are intellectually unrelated, we shall certainly have suffered, I think, an erosion of the authority of science. For how can we be sure that any one set of scientific beliefs is better, more demanding of our acceptance, than any other?

I will give you my own opinion: there <u>is</u> progress in science, in the sense that changes in conception are sequentially related, but not in the sense that its direction is strictly determined nor that there is a knowable goal or end toward which we are striving. I think of science, you see, as biologists think of evolving species:[13] what an evolving system is at any given time depends on what has preceded; it is contingent upon events that cannot be predicted but that bring about further change. New scientific theories do not arise, as I have indicated earlier, from an intellectual vacuum; they do depend upon what men have thought and observed before. Yet they cannot be said to be entirely determined by previous thought, as the accidents of men's lives and their experiences are too much a part of the process to suppose that science has an ineluctable, rectilinear course to run. Scientific change is adaptive, however unpredictable it may be, for it rejects error and provides new means of making sense of our expanding knowledge. Adaptation in the world of knowledge may be all there is to scientific progress just as adaptation may be the sole criterion of progress in biological evolution.

It is possible that our knowledge of natural laws will in time be complete and perfect. But we cannot know this to be true: if indeed we knew what the end was, it would hardly be necessary to reach it. Moreover, our experience thus far has been that as we understand more, we learn of more to understand. Perhaps this experience too has been disillusioning to some, but I do not think it need be either disheartening or a discredit to the quest for scientific authority. We humans are, after all, tiny creatures within a vast universe we never made. That we cannot master it or comprehend it totally should make us humble, but we can be stirred by the capacity to understand our condition that no other living species, at least on this planet, has yet acquired. Indeed, we either employ the powers of reason

with which evolutionary strategy has endowed us, or we cease to be humans. It is not impossible that, even if we exercise our rational powers, we may eradicate the human species. But there is only one way for us to contribute to the guidance of further human evolution and that is by being truly rational animals. If we choose this way, we shall continue to employ science, because it is a method of reason that has proved worthy as a result of the tests and challenges to which it constantly exposes itself: is the current body of scientific beliefs internally consistent and externally compatible with what we experience? does this body of beliefs make for an understanding of the order and regularity we perceive in nature?

It is certainly right to ask whether science alone can tell us what we should do, what conditions for human existence we ought to promote. I am sure that the quest for scientific authority will not in itself be sufficient. To choose our fate requires prior notions of the beautiful and the good, and these precede science and do not simply follow it. I do not wish to be misinterpreted in this regard. I am not merely asserting what many philosophers, historians, and scientists now accept to be true, that the values scientists hold affect their inquiries.[14] I wish to suggest that the results of science can and do also affect our values, and this is as it should be. There is, if I am right, a sort of feedback relationship between science and values. Our notions of the good certainly influence the direction of scientific inquiries, but the results of these inquiries may come to have important, even if unexpected effects upon the shaping of ethical values.

Let me give but one example of what I mean. In the history of man's thought, the idea of the great chain of being once had enormous influence. According to this idea, all things in the universe were arranged by divine plan in a continuous but hierarchical scale from the inanimate through the tiniest creatures, then the plants, the animals, through man who dominated all mortal life, eventually through the hierarchies of angels and subdivinities to God himself. Every level was filled in this continuum, and so far as man himself was concerned there were several levels. The classes of feudal society, from peasants to nobility, could in fact be thought of a constituting the human continuum. So long as this scale of being was regarded to be a static one, as it was indeed regarded for a long time, there was held to be a preordained place in human society for each kind of man, and his place was transferred to his heirs. Such a conception was, of course, that of a fixed, immobile society and reflected ideas of absolute, eternal values. When largely through the studies of geologists and biologists, the conception of a fixed order in nature gave way to that of evolution, which included man, the possibilities of social mobility and human transformation were eventually accepted. With this acceptance came vast changes in our ideas of the social and political good. Human freedom has an entirely different significance in a fixed than in a mobile society.

If there is a lesson in all of this, I think it lies in the idea of evolution. Man has not always existed, the origins of science are relatively recent in the history of mankind, beliefs change. I think many of our troubles in the past and in the present stem from a lack of awareness that changes of

belief have extended to ethical considerations. Men have longed for ethical constants, eternal values. But I am not sure that longing is justified in view of the evidence that values, like beliefs, are human and change.[15] Perhaps the crisis of authority in our times is not simply a question of its loss, but rather a question of human adaptation to the idea of a continuing quest for authority, in all human affairs as well as in science. The crisis of authority may be concerned with the human capacity to replace beliefs with "better" beliefs, beliefs that make such sense of our perceptions that men come to share them, beliefs that permit men to evolve.

NOTES

1. Between Past and Future (New York, The Viking Press, 1968), especially Chapter 3, "What is Authority?"

2. Ibid.

3. Ibid.

4. The distinction between power and violence is developed in Hannah Arendt's essay "On Violence," Harcourt, Brace and World, Inc., New York, 1969.

5. Karl Popper suggests in Conjectures and Refutations (New York, Harper Torchbooks, 1968, Chapter 1, p. 49) that regularity and order are imposed by man on nature, rather than the other way around. Settling this question may depend upon whether one can separate man from nature. My own view is that man is in nature and that his propensity to see order may be the consequence of the very orderliness of his genetic constitution. He may, in a sense, have no option, if the orderliness of nature is integrated into his very structure.

6. Science as an expression of the Neitszchean "will to power" is the theme of Gunther Stent's The Coming of the Golden Age (New York, Natural History Press, American Museum of Natural History, 1969). Stent concludes, however, that when there is little or nothing more left to understand and, consequently, no further increase possible in our power to control, science will come to an end. There are reasons to doubt such an end to science, as I have suggested below and discussed elsewhere ("Transformations in Biology," Science 172: 364, 1971).

7. The Structure of Scientific Revolutions (Chicago, The University of Chicago Press, 1st ed., 1962; 2nd ed., 1970).

8. See, for example, Dudley Shapere's review of the first edition of Kuhn's book, Philosophical Review LXXIII: 383, 1964.

9. Karl Popper, Conjectures and Refutations (New York, Harper Torchbooks, 1968).

10. Nor is it even inducible from the facts, in the sense of being a generalization of the facts. See Karl Popper, ibid.

11. Philip Abelson, in an editorial in Science, March 29, 1963, puts it another way. "Part of the strength of science is that it has tended to attract individuals who love knowledge and the creation of it. Just as important to the integrity of science have been the unwritten rules of the game. These provide recognition and approbation for work which is imaginative and accurate and apathy or criticism for the trivial and inaccurate...," thus tending "...to make honest, vigorous, conscientious, hardworking scholars out of people who have human tendencies of slothfulness and no more rectitude than the law requires."

12. A discussion of this question is contained in Criticism and the Growth of Knowledge, edited by I. Lakatos and A. Musgrave (New York, Cambridge University Press, 1970).

13. I have earlier tried to express this view of science as an evolving system in my Evolution of Genetics (New York, Academic Press, 1965) and in my review ("Transformations in Biology," Science 172: 364, 1971) of Francois Jacob's book La Logique du Vivant. I find that this view is shared with Stephen Toulmin, who makes a nice case for it in the last chapter of his Foresight and Understanding (New York, Harper Torchbooks, 1961).

14. See, for example, Warren Weaver's essay in the February 1972 issue of the Bulletin of the American Association for the Advancement of Science (Volume 17, Number 3).

15. There is another sense, of course, in which values change. Values often conflict and we often have to rank them. Their rank order may be changed, however, depending upon the context. Thus, for example, freedom of individual expression may be given great weight except in some, although not all, contexts in which it interferes with the liberty of others. Similarly, we might argue (in opposition to Leon R. Kass, "Implications of Pre-Natal Diagnosis for the Human Right to Life," in Proceedings of a Conference on Ethical Issues in Genetic Counselling and the Use of Genetic Knowledge, Fogarty International Center of the National Institutes of Health, 1972) that protection of the unborn fetus is to be valued except when amniocentesis makes clearly evident its genetic defectiveness and the great likelihood that birth would bring extreme suffering to its parents. Yet we need not argue that the unborn fetus should be sacrificed whenever amniocentesis reveals that the future child is likely to bring sorrow to its parents (as, for example, when the child is of the sex undesired by the parents). It is wrong to suppose that in a conflict of values we should or can regard the same one as overriding in every situation.